

## VARIATION OF GATE MATERIALS FOR HYBRID GE-SI MOSFET

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### ABSTRACT

A comparative study on Hybrid MOSFET with different gate materials has been investigated in this paper. The objective of this study is to analyze the performance of Hybrid MOSFET with different gate materials. In this study drain current values for different gate materials are calculated for a given gate voltage by varying the drain voltage. The outcome of this study is to find a better gate material for Hybrid MOSFET.

**KEYWORDS:** Hybrid Mosfet, Drain Current

### INTRODUCTION

The growth of digital technologies like the microprocessor has provided the motivation to advance MOSFET technology faster than any other type of silicon-based transistor [1]. Over the past decades, the MOSFET has continually been scaled down in size; typical MOSFET channel lengths were once several micrometers, but modern integrated circuits are incorporating MOSFETs with channel lengths of tens of nanometers.

Smaller MOSFETs are desirable for several reasons. The main reason to make transistors smaller is to pack more and more devices in a given chip area. This results in a chip with the same functionality in a smaller area, or chips with more functionality in the same area.

The performance of MOSFET can be improved by using different materials with same structure and size. Instead of reducing the channel size drain current can be reduced by using different material set [2]. By using two different substrate material the performance of MOSFET can be improved.[3]. Hybrid MOSFET with different gate materials can be studied and the material with lower drain current value can be identified.

### OVERVIEW OF DEVICE DESIGN

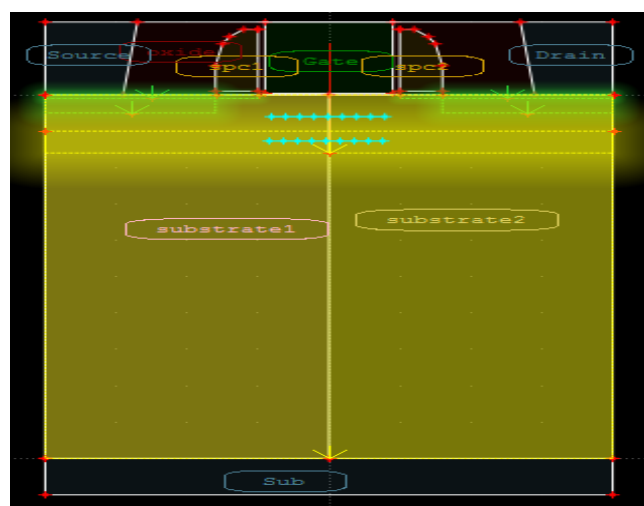


Figure 1: Structure of Hybrid MOSFET

### Specifications

Gate material: NPolysilicon/Aluminium/Titanium/Tungsten/Titaniumsilicide/Copper/Gold/Silver

Source material: Aluminium

Drain material: Aluminum

Channel doping:  $1e+18 \text{ cm}^{-3}$

Substrate 1: silicon

Substrate 2: germanium

Figure 1 gives the structure of Hybrid MOSFET. It has a single gate whose materials are varied. It has two substrate made of silicon and germanium

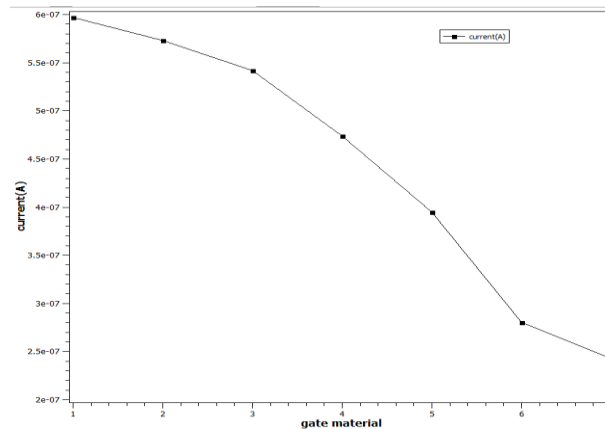
### SIMULATION RESULTS

In this section transfer characteristics of hybrid MOSFET with different gate materials has been studied using visual TCAD software.

**Table 1: Comparison of Drain Current for Various Gate Materials**

VDS (V)	NPOLY (A)	Al (A)	Ti (A)	W (A)	Cu (A)	Au (A)	Ag (A)
0	-1.37E-06	-1.34E-06	-1.28E-06	-1.17E-06	-1.03E-06	-8.07E-07	-7.27E-07
0.2	4.06E-07	3.96E-07	3.80E-07	3.46E-07	3.03E-07	2.34E-07	2.08E-07
0.4	4.79E-07	4.66E-07	4.46E-07	4.04E-07	3.50E-07	2.59E-07	2.27E-07
0.6	5.33E-07	5.16E-07	4.93E-07	4.41E-07	3.75E-07	2.69E-07	2.34E-07
0.8	5.71E-07	5.51E-07	5.24E-07	4.63E-07	3.88E-07	2.75E-07	2.38E-07
1	5.97E-07	5.73E-07	5.42E-07	4.74E-07	3.95E-07	2.80E-07	2.43E-07
1.2	6.12E-07	5.85E-07	5.52E-07	4.83E-07	4.02E-07	2.85E-07	2.47E-07
1.4	6.22E-07	5.95E-07	5.61E-07	4.90E-07	4.08E-07	2.90E-07	2.52E-07
1.6	6.31E-07	6.03E-07	5.69E-07	4.97E-07	4.14E-07	2.95E-07	2.57E-07
1.8	6.40E-07	6.11E-07	5.77E-07	5.04E-07	4.20E-07	3.00E-07	2.61E-07
2	6.48E-07	6.19E-07	5.84E-07	5.11E-07	4.27E-07	3.05E-07	2.66E-07

In the simulation the gate material of Hybrid MOSFET has been varied and the drain current value has been noted by varying VDS from 0 to 2 V with a step voltage of 0.2V maintaining VGS as constant value (2V).



**Figure 2: Comparison of Drain Current Values for Different Gate Materials**

Figure 2 shows a graph with various gate materials along x-axis marked 1,2,3.. with respect to the order shown in Table 1 and corresponding drain current values are plotted along y-axis for VDS equal to 1V.

From the figure it can be seen that the drain current value of Hybrid MOSFET with silver as gate material is lower when compared with other gate materials. The drain current value of Hybrid MOSFET with gate material NPolysilicon is higher when compared with others.

## CONCLUSIONS

This paper has explained about the performance of hybrid MOSFET with different gate materials. By varying the gate materials without altering other parameters the drain current value is noted. It was found that using silver as gate material the drain current value can be reduced to a lower amount when compared with other materials.

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